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PAGE

THE ORGANIC-CHEMICAL CONTROVERSY IN AGRICULTURE ..... *Ehrenfried E. Pfeiffer* 2

GRINDSTONE RUN BECOMES A SUMMER STREAM ..... *Sterling W. Edwards* 20

AVAILABILITY OF NITROGEN, PHOSPHATE AND POTASH IN SOILS ..... *Ehrenfried E. Pfeiffer* 24

BOOK REVIEWS 27

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THE ORGANIC-CHEMICAL CONTROVERSY IN AGRICULTURE

EHRENFRIED E. PFEIFFER

Many articles have appeared recently discussing the use of chemicals versus the organic method in agriculture. The general tendency in all these publications is to express appreciation of certain of the values of organic matter but to criticize the organic movement as a whole as fanatical, mystical, and to state that this country has about doubled its acre yields with chemical fertilizers while there would not be enough organic material (manure, compost, green manuring) available to supply the needs of a high production agriculture. One particular criticism of the organic movement that is often voiced is that the "fanatics have claimed that chemical fertilizer poisons the soil and spray residues on fruits and vegetables are a menace to public health." It is also frequently stated that scientific tests have shown no difference in yield and in vitamin production in plants, whether grown organically or chemically. It has even been shown that plants can grow, produce fruit, and contain all necessary mineral elements, proteins and vitamins if grown in properly adjusted nutrient solutions without any soil at all.[1] [2]

Occasional emotional outbursts on both sides of the argument can be left out of the picture. They help neither cause. We need only take an objective stand in making a mental inventory of present day knowledge.

This writer has spent more than 25 years in the study of organic matter in soils, has done laboratory as well as field research, has practiced farming and consulted with other farmers and growers. He has proved, in making a living on his own farms, that his point of view works. He speaks out of practical experience and does not indulge in theories. He does not take part in some of the outbursts of the organic movement for he is a scientist for whom only facts count.[4] Nor does he share in the attitude of the other side that chemical fertilizers will solve all the problems of survival. Somewhere between the two there must exist a workable path which must be sought for the sake of the maintenance of fertile soils. The writer has

tried, therefore, to apply scientific methods to the organic idea. This is what he has found:

The defenders of the organic method are enthusiasts not out of sheer intellectual delight but because they have tried "something" in the garden and field and have observed results which they could not obtain otherwise. They have had troubles with their soils which have disappeared. One cannot consequently blame them for their enthusiasm. They would, however, do well to report only facts and findings and omit enthusiastic and critical statements or opinions. The facts speak for themselves. Then it should also be realized that many statements made years ago in favor of organic matter have become common knowledge today, even among the orthodox, and it should be acknowledged that the value and importance of organic matter is no longer doubted. To fight against science as it was years ago is really ridiculous.'

It should be acknowledged by both camps that not all the problems have been solved. Open and unprejudiced discussion of the unsolved problems will lead to the fruitful path.

There is, for instance, the organic school's statement that insect pests can be overcome when no inorganic, chemical fertilizers are used. This writer has found insects and fungi diseases in organically treated orchards, gardens and fields, but he has also observed that they were reduced to a bearable minimum and did not spread like wildfire. On the other side he has also seen some fertilizer treated land relatively free of pests. However to pretend that sprays and economic poison have licked the problem is a far cry from reality.

Dean Stanley B. Freeborn of the U. C. College of Agriculture reported recently to the National Agricultural Chemical Association in San Francisco: "Despite the use of chemicals, the annual loss caused by insect pests is about $4 billion; losses due to fungi and other plant diseases is another $4 billion and weed damage about $5 billion, a total of $13 billion. Without the use of chemicals it would have been vastly more."

No wonder the farmer gets worried, searches, and begins to doubt that his present methods are the sure cure. It costs him a lot of money to combat diseases and pests and frequently he spends all that he gains in dollars in yield in order to maintain this yield.

Insecticides and weed killers have done wonders. But they have also backfired. Insects have become immune to DDT and

other insecticides, the natural enemies of destructive insects have been killed and the pests—after overcoming the first impact of the new insecticide—have developed more vigorously than ever. The trend now is toward biological control in certain areas without insecticides, but this necessitates the restoration of natural balances as the first step.

It is true that the skillful use of fertilizers has increased yields.* On the other hand, it has been observed that soil structures have declined; hardpan, crusted and impenetrable surface soils have appeared; in general, unfavorable soil structures have developed. Fertilizers have washed out and become unavailable. There is, for instance, the statement by H. D. Chapman of the Riverside Citrus Experiment Station, *Progress Made in Tree Feeding* (Citrus Leaves, Feb. 1952), reporting that, in lysimeter tests over a period of 15 years, 3,552 pounds of potassium, 448 pounds of nitrogen, 227 pounds of phosphorus were lost in spite of a cover crop of mustard during the winter and in spite of the fact that each year calcium nitrate at the rate of 200 lbs/acre was added. The pH changed from 6.6 to 7.9 during this period, and chlorine increased to 119 pounds and sodium to 1913 pounds, both undesirable.

The onesided use of fertilizers geared to provide only NPK has disturbed the balance of soils and created trace mineral deficiencies. Through exclusive emphasis on the NPK over many years, research as well agricultural practice has neglected the importance of biocatalysts in plant growth. Scientists are now in a hurry to catch up.

Phosphate fertilizers have become unavailable. Radioactive tracer studies have shown that probably only 2 to 10% of the phosphate applied will remain available. The rest is locked up in the soil, may be washed down into deeper layers inaccessible to plant roots. Whether these fertilizers will act as a reserve and can be brought back into available forms nearer the surface depends entirely upon the proper treatment of the soil. It will certainly not become available if crusted soils and hardpan prevail. (The increase of organic matter counteracts the process of increasing unavailability.) It is now acknowledged that deep-rooting weeds play an important and beneficial role in this regard. Alkaline soils lock phosphate up completely. While in acid soils the use of natural rock phosphates as recommended by the organic school can be beneficial, in alkaline soils the rock phosphate may become and remain unavailable unless there is such microlife in the soil as to render it available.

Similar conditions exist as regards potash.[7] There may be tremendous amounts of potash bound up in the soil but these are not available and it is the farmer's task again to increase and mobilize microbial action in order to make these potash reserves accessible. On the other hand, water soluble potash fertilizers may be washed out in areas of high rainfall or intensive irrigation and be completely lost. Fertilizer legislation has helped to increase losses of valuable "plant food" by emphasizing the use of available phosphate and potash in fertilizers. This emphasis was based on the old concept of availability and water solubility apparently making these fertilizers readily accessible. However, the fact that these fertilizers become unavailable or are washed out at once when they encounter certain soil conditions was not taken into consideration. Organic matter again, by means of its high absorption factor and retentive capacity would play a beneficial part by holding the fertilizer in exactly that surface layer where it can do its best for the growing roots. Organic matter, with its microlife, allows a slow but steady release of important minerals and cuts down excessive losses and washing out.

Applying fertilizers to soils low in organic matter or where they can be locked up or washed out can become a rather wasteful practice. Many farmers have observed that they have to use more and more from year to year in order to maintain yields. At the same time they are fighting hard against increasingly unfavorable soil structures. They really want to know how to make less fertilizer go farther. This is what the much criticized organic farmers have now observed that they can do. Hence their enthusiasm. Organic matter feeds the microlife of soils. Soil bacteria in turn make minerals available and increase organic matter in soil. Organic matter is the savings account of the soil. It stores moisture and maintains this moisture longer during periods of drought. On the other hand, it readily absorbs water and reduces the danger of "wet feet" for plant roots which may cause root rot and fungus infection.[8]

One acre of surface soil weighs approximately two million pounds. An organic matter content of 2% amounts to 40,000 pounds of organic matter of all varieties. On the average, 5% of the organic matter is nitrogen, or 2,000 pounds of organic nitrogen can be present at the 2% organic matter level. Microorganisms are the richest source of nitrogen since their bodies contain as much as 10 to 12% nitrogen. At a 1% organic matter level the organic nitrogen reserve is 1,000 pounds, at a 3%

level the reserve is 3,000 pounds, and so on. This reserve can easily be lost. It can also be maintained. Humus which is the "digested" form of organic matter and rather a "state" of matter in soil than a chemical, is stable when proper methods of cultivation are used and the microorganisms and their life cycle are maintained. To have 2% organic matter does not necessarily mean that there is 2% humus present. But a high microlife in soil with a soil reaction between pH 6.0 and 7.5 and proper aeration of soil indicates a high humus level. In fact, the more aerobic soil microorganisms are present the higher will the humus fraction be. The carbon-nitrogen relationship of 10:1 or 11:1 is the ideal one and exists in humus.

"Humus is usually in a high dynamic condition, for it is constantly being formed from plant and animal residues and is continuously being decomposed by microorganisms. It serves as a source of energy for various groups of microorganisms . . . Humus is highly colloidal . . . Humus is characterized by a high cation-exchange capacity; it combines with various inorganic soil constituents; it absorbs large quantities of water . . . it has already been shown that soil humus is an important factor in the control of aeration, water holding capacity and granulation of field soils. Humus possesses other physico-chemical properties which make it a highly valuable soil constituent."

These statements (taken from *Fundamentals of Soil Science* by C. E. Millar and L. M. Turk, John Wiley & Sons, Inc.) and similar ones can be found everywhere in scientific agricultural literature nowadays. Nor is this the exclusive knowledge of a small group any longer, but it is general knowledge. If a scientist or agricultural writer were to raise his voice against the importance of organic matter he would be denying the progress of his own science. A further example is by Firman E. Bear in *Soils and Fertilizers*: "Any system of soil management which increases the soil's content of organic matter, proportionally increases its microbial population, with all the advantages that accrue as a result of their activities. This is one important reason for having a cropping system which maintains a high content of oganic matter in the soil . . . The total microbial population will be closely related to the soil's content of organic matter since this constitutes the primary food of most soil microbes.

"After these organic materials have undergone decomposition to the point at which they may be classed as humus, they constitute an important portion of the colloidal matter of soils.

In sandy soils this is of particular importance in that the humus serves in the same capacity as clay to form a binding material for the coarse particles. In clay soils, the colloidal humus tends to bind the finely divided particles together in the form of granules. During periods of drought, these organic colloids are dehydrated, and rehydration is very slow. Their granulating effect is more permanent than is that produced by inorganic colloids."

One important point in Firman Bear's statement should be impressed upon every organic enthusiast's mind, namely that "after organic materials have undergone decomposition to the point at which they may be classed as humus . . . ." Much harm has been done by the application of raw, insufficiently decomposed organic matter which ties down nitrogen and bacterial life during the decomposition period. Many an organic farmer has suffered these consequences through ignorance of the fact that science long ago established the conditions under which the application of organic matter as humus can be beneficial. It is of extreme importance that completely decomposed organic matter be used for fertilizer. Here both the opposing camps have made mistakes. The one in recommending plowing or disking under fresh manure as it comes from the barn. To do this leads first of all to losses of nitrogen and ties down soil life until the manure is decomposed or digested in the soil. Hence the observation of the slow action of manure which becomes apparent only after several months or even only in the second crop. Should the first crop be one which needs much nitrogen at once the readily available nitrogen fertilizer gets the upper hand and makes a better showing. It has, however, been observed that the high nitrogen fertilizing produced only temporary and not lasting results, had to be excessive (and expensive) which in turn had unfavorable influences on the physiology of the growing plants (too fast a growth, lots of foliage but reduced seed production, increased susceptibility to pests and diseases, lowered vitamin content). The increase in bulk yield of green plant masses is not always a success. In the case of pasture grasses it may cause bloat in cattle. In legumes it reduces the formation and action of nitrogen-fixing bacteria which then consume instead of fixing nitrogen.

The organic school on the other side, has recommended sheet composting, i.e. the spreading and disking or plowing under of raw organic materials, garbage, etc., which has the same result of tieing down the soil life. Many who have tried it have re-

ported to this writer that it was a sure way to spread diseases. Legumes, especially beans grown on land treated in this way showed yellow leaves and yielded poorly.

Firman Bear further says in *Soils and Fertilizers*, page 73-74: *The Effect of Organic Matter* "The application of liberal amounts of manure and the incorporation of plant residues, including the roots, apparently have the effect of developing lines of weakness which prevent the forces of cohesion from being sufficiently effective to permit the formation of clods. Repeated heavy applications of manure may so affect the physical characteristics of a clay soil as to make it take on the qualities of a loam. Occasionally, quite the opposite effect is noted. In soils that are somewhat wet and in which the oxidation of the added organic matter is relatively slow, the application of manure delays the drying-out process, with the result that in early spring it may be difficult to find a favorable moisture condition at which to work the soil."

Bear is perfectly correct in these last statements. However, the use of completely decomposed, that is composted, manure will entirely overcome this difficulty. The bacterial treatment of manure, compost, and the soil itself, as reported in an earlier number of this magazine, has completely eliminated the dangers mentioned above. When even famous authorities in the field of bacteriology pretend that the organic matter rots anyhow, that bacterial or other preparations are not needed or are "mystical," they reveal, regrettably enough, that they have never tested it out and that they are not up on recent developments. The critical designation "mystical preparation" is unjustified. Something is mystical only when one doesn't know about it.

Interesting data on the results of mulching in reduced water losses is also reported by Professor Bear:

Tons of Water Evaporated from Acre of Soil With and Without Mulch

(Data for a period of 100 days.)

Table 38

Depth of Mulch	*Clay Loam*	*Black Marsh*	*Sandy Loam*
None	2,414	588	741
1 inch	1,260	355	373
2 inches	979	270	339
3 inches	889	256	287
4 inches	883	252	315

"Under the conditions of the above test, the losses of water by surface evaporation were practically cut in half by the use of a mulch.

"Mulching decreases or inhibits the capillary flow, and diffusion through the mulch is practically negligible. This practice is very effective in conserving soil moisture and is founded on sound scientific principles. An especially interesting illustration is brought out in the comparison of the loss of water from a soil under arid and humid conditions respectively. As might be expected, the loss at first is much more rapid under arid conditions, so rapid in fact as to tax the soil's ability to move water from within to the surface by capillarity, and in consequence a dry layer is formed which keeps the subsequent losses far below those which take place from the soil under humid conditions, where the capillary flow to the surface persists until the moisture content of the whole soil is very low indeed."

If all this which outstanding scientists themselves tell us about organic matter—and the farmer knows from experience how true it is—that he is inspired to build up the humus content and microlife of his soil should be understandable. Any argument against the building up of organic matter in soil is contrary to the interest of the farmer which is to improve and maintain the staff of his life—namely, a living soil which holds or stands up for centuries, which is the basis of progress for any nation in any epoch.

Some critics do not deny the validity of this. However, they do not believe that it can be done. There is not enough organic material in the world by way of manure and compost, even including green manures, to provide the soil with all its needs, they say. This definitely is not an argument against the organic idea. It is rather a challenge. That a fellow is poor is certainly not an argument for him not to earn money or to stay out of business. It is a stimulus to do something, to get going. The average organic matter content of the soils of the United States today is 1.5%. Virgin soils ranged from 4 to 6%. Truck farms and grain farms frequently have soils with a content below 1.5%, yes even below 1% organic matter. The borderline, according to this writer's observation, is about 1.5%. Below this, soils break down rapidly and are unable to "hold." They have lost their reserves and the application of fertilizers will not feed and build up the soil but only provide it with the absolute needs for plant growth. The situation is the same as

that of the fellow who makes no profit in his business and can spend only as much as he is barely able to make. Many farmers are in this situation today with regard to their soils.

The collection of wastes and their processing is imperative, if we ever want to solve the problem. If our soils continue to decline, the farmer will not even be able to buy fertilizer in the future. To discredit sound humus practices and the processing of wastes in large plants as has recently begun, is about the most shortsighted policy of some scientists and agricultural writers ever to be offered to the farmer.

When mineral deficiencies were discovered everybody jumped on the bandwagon and tried to develop the fertilizer business. Now we see the damage done by humus deficiencies —and many workers in the field are discredited because they try to heal and amend them. The fertilizer boys will one day—we hope not too late for them—discover that increased humus production in soils will make their fertilizer last longer and be more effective if used with reason and will profit from the situation. They certainly cannot help but profit if the farmer has built up reserves in his soils and become more stable in his business. The bank or insurance company with a large reserve capital is considered to be the safest. Equity funds mean gambling or taking a chance. Why not apply the same reasoning to soils?

There is evidence that soils can be handled successfully with increased organic matter, even without additional fertilizers. This writer has grown a wheat for twenty years on organic soils, using the bio-dynamic method by the way, which always yielded above the average of the area with some of the highest yields ever obtained. This wheat also showed one of highest mineral contents, including trace minerals, and a high protein content above the level of its kind anywhere else.

It must, however, also be stated that small amounts of fertilizer combined with the organic method have done no harm to soils. Excessive amounts of fertilizers have reduced vitamin and protein contents. With the proper organic treatment, fertilizers can be reduced to a harmless minimum. The organic movement, nevertheless would be wise to be tolerant. There are many areas where there is no livestock, therefore no manure, where there are no other sources of organic materials. These areas have to continue to use fertilizers until such time as sufficient organic fertilizers are produced to take care of their needs too. It is quite a different problem to work organically

in small gardens and fields from that which arises in areas where thousands of acres are intensively cultivated with no access to organic matter. In such regions the use of green manuring is imperative and the only source for the time being. But then, the green manure should be broken down with bacterial action in order to avoid the dangers mentioned earlier. In due time the use of composted organic wastes will develop and improve the situation.

One observation should give food for thought to the most ardent opponent of the organic method. The outstanding property which all soils that have lasted for hundreds of years under cultivation and remained productive have in common is their high content of organic matter and microlife. The soils which broke down, showed erosion, and needed more and more fertilizer but still did not improve, had lost their organic matter and had a low microlife. To simply state that fertilizers have increased yields is correct but still not the whole truth. The question is "at what expense have these yields been obtained." Have we not lost many soils in this process? Have we not lost capital, i.e. lasting soil fertility in spite of increased yields? The fact that soil conservation has become a must should bear out our point.

The facts about soil life are known. Why not let them work toward starting a new, progressive phase in agriculture, creating new industries and processes, as they are already on the march?

Bibliography, Quotations and Comment

1. J. S. Jaffe. The Relative Merits of Inorganic and Organic Sources of Plant Nutrients. *Better Crops With Plant Food*, March 1952.

Chemicals-Fanaticism and Fact. *California Farmer*, May 17, 1952.

2. C. K. Beeson, Plant, Soil and Nutrition Laboratory, U. S. Dept. of Agric. pp. 64-67.

Chemicals in Food Products. Congressional Hearings. H. Res. 74. part 1. Committee to investigate the use of chemicals in Food Products. 82nd Congress.

This hearing is of the greatest importance, providing reports and evidence not only on the use of chemicals in agriculture and in foods, but especially discussing at large the much disputed use of insecticides. It appears from reading the material presented that a proper labeling law for organic products is as necessary as were the labeling laws for foods, pharmaceu-

ticals and fertilizers in the past. The customer needs assurance that he is getting agricultural products unadulterated, with none or the harmless minimum of insecticide residues.

3. Some of these articles in favor of inorganic fertilizers are probably well meant but they lack careful study of the organic problem, voicing only opinions and revealing insufficient knowledge of actual organic practice. In the scientific literature about organic matter in soils one can find almost all the arguments in favor of organics and one need not resort to the organic literature to contradict these statements.

4. Many organic composting enthusiasts overlook the fact that their practices can easily be followed on small, diversified farms, in small gardens, and in places where organic source materials and manure are readily available. If one deals with large farms, with areas of horticulture, truck farming, monocultures (cotton, citrus fruits, for instance) where there is no organic source material, or if one has to handle large amounts of wastes, municipal garbage for one, at the rate of hundreds of tons per day, then organic methods require adjustment. The mechanical handling of such bulky materials at an economic level is something which needs careful study and experience. It is not a matter for amateurs. The best brains of the country have to study the problem and really create organic engineering as well as an organic science in general.

5. One need only scan the scientific literature and agricultural textbooks of the last two years to find about everything in favor of organic matter and its importance. The very same literature which contains data in favor of minerals also reports plenty of data substantiating the need of organic matter. One of the best brochures on the subject was, for instance, published by the National Fertilizer Association. Pamphlet No. 136, Organic Matter *the Life* of the Soil.

Also interesting with regard to obtaining top results with organic matter are: Studies with Organic Materials for Vegetable Crops by L. M. Ware, W. A. Johnson. Agricultural Experiment Station, Alabama Polytechnic Institute. Bulletin 280, June 1951. The Wrong Turn by Firman E. Bear (Rutgers University). Journal of Soil and Water Conservation, Vol. 6, No. 2. April 1951.

". . . . Usually a nitrogen top-dressing or side-dressing produces such marked growth and color effects as to be very readily seen, assuming that a check area is available for comparison. This means that the supply of organic matter, the storage agent

for nitrogen is inadequate. Other evidence of lack of organic matter is found in the increasing tendency toward minor-element deficiencies in cultivated soils that have been brought to a high level of productivity by heavy use of concentrated inorganic fertilizers.

"Instead of looking with a jaundiced eye at the efforts of the organic-farming enthusiasts to develop organic matter supplies for use on the soil, the fertilizer industry would do well to interest itself in this problem. There is need for study of the possibilities for recovery of city wastes. . . .

"These data point in the direction of the need not only for more organic matter but a variety of kinds of it, no matter whether we are thinking of a cover-crop system or one involving sod crops. Many weeds make highly important contributions in mobilizing minor elements in the soil. Ragweeds and lamb's quarters, for example are excellent accumulators of zinc. It is conceivable that they might be deliberately grown for the purpose of mobilizing this element.

"Sod and cover crops should be liberally fertilized with complete fertilizer. Nitrogen alone is not desirable, since this tends to develop top growth at the expense of roots. A complete fertilizer helps them to develop not only larger tops but larger root systems as well that accumulate more mineral elements from the lower soil depths. When such sod and cover crops are worked into the soil, they provide excellent food for soil microbes, and these microbes liberate large amounts of all the essential mineral elements, including nitrogen, from them.

"The fertilizer industry represents the most important chemical development, in terms of human values, the world has ever known. Fertilizers can be made to stand between us and any possible deficiency of food for centuries to come. But fertilizers alone, no matter how heavy the rate of application, will not meet the requirements for soils that are producing cultivated crops. Soil must be fed organic matter in larger amounts than the roots and residues of such crops can provide. This requires manure and well-chosen mixtures of sod and cover crops. If, in addition, we can develop means of producing supplemental compost from city refuse, or by any other means, so much the better. In my opinion we should lend assistance to efforts that are designed to avoid waste of organic materials. It might well pay to subsidize the processing of such organic wastes as can be made available for use on intensively cropped land."

Textbooks like the following contain valuable material for the appreciation and understanding of organic matter in soils and microbial action:

Soils and Fertilizers by Firman E. Bear. John Wiley & Sons, Inc. *Fundamentals of Soil Science* by C. E. Millar and L. M. Turk. John Wiley & Sons, Inc., New York.

6. *Soil Organisms—Fact and Fiction* by Dr. James P. Martin & Jarel O. Ervin. Western Grower and Shipper. May 1952, Vol. 23, No. 6.

"In most soils there is insufficient decomposing organic matter to meet the nutrient requirements of cultivated plants during the period of maximum growth. Even if organic manures are added, it is not certain that sufficient nutrients would be liberated to give optimum plant growth. Certainly if all farmers were forced to rely on organic fertilizers only, the available supply would not begin to furnish the required amount for good crop yields. Our high production is dependent on substituting or supplementing organic with inorganic fertilizers. Further increases in crop production will result largely from increased use of inorganic fertilizer and better soil management practices which include the use of green manure crops, rotations, and organic manures when available."

If green manures and organic manures are part of the better soil management, so this writer thinks, why not improve the effects of green manuring, manures and composts as outlined elsewhere in this issue? Why forget those who are trying to improve the situation and why not try to get more organic fertilizers if there are not enough. The above quoted scientists report in a table bacteria counts of soils, untreated and treated with cover crops and calcium nitrate fertilizers. The highest count of bacteria they report is 35 Million per gram of soil. In our practice on skillfully treated organic soils, counts of 500 to 800 Million per gram are not rare.

In talking with hundreds of farmers and growers all over the country there is one phrase one hears over and over again: "We know we can grow higher yields with fertilizers but we also know that we don't do any good to our soils with them. We have to learn now how to build up our soils." The experimental stations would do well to heed this remark and work with the farmers and growers. At the present moment there is a deep cleft between the scientist, the farmer and the fertilizer man. The promise of higher yields is frequently based on an erroneous concept. Yields cannot be increased indefinitely and not on a

constantly rising curve. The limiting factor is water. If there is a lack of water or an insufficient supply of it, no fertilizer will increase the yield any further than the moisture reserves of the soil will allow. Here the importance of organic matter becomes clearer than anywhere else, for it increases the water-holding capacity of the soil.

7. *The Inorganic Side of Life* by Firman E. Bear. Better Crops With Plant Food. April 1952.

"Considered in relation to the needs of animals and man, two points should be emphasized. First, by using excessive amounts of potassium fertilizers the potassium content of plants can be raised to such levels as to materially reduce the calcium, magnesium and sodium contents. This is contrary to the best interests of the consumers of these plants, since from the quantitative point of view calcium is much more important than potassium to animals. Secondly, in proportion as acre yields are stepped up through the production of more carbohydrates, as in the case of hybrid corn, the percentages of all the minerals in plants are lowered. Potassium is known to be of value in the animal body, but an excess should be avoided . . . gross tetany is related to too high a potassium content . . . as a result, the amounts of calcium and magnesium in these plants are greatly reduced. The imbalance between potassium and calcium interferes with the normal rhythm of the heart. Similarly, a lack of balance between calcium and magnesium affects muscular activity . . . the magnesium content of the blood of these animals is often very low.

"Much more attention is being paid to minor elements now than formerly because of widespread deficiencies. Some of these deficiencies are a result of serious soil erosion, with consequent loss of organic matter. Others are due to losses of the elements by way of harvested crops during many years of farming. The substitution of the tractor for the horse has added to the difficulty, since this often means more acres under cultivation and less manure for use on the land. Higher acre yields, obtained by planting hybrid seed and using larger amounts of NPK fertilizers, have increased the need for these elements in the soil. And the ever greater purification of materials that go into the manufacture of fertilizers has added the final touch to the trouble."

Prof. Firman Bear, an authority on fertilizers, should be commended for the objective stand he takes in these matters as well as for his appreciation of organic matter in soils, the use

of organic wastes, the importance of weeds as sources of trace minerals.

The mere addition of the missing trace minerals to the fertilizer or soil doesn't solve the problem for these minor elements need to be present in a form which avoids the locking up in the soil but renders them acceptable to the selective action of plant roots. For the record, it may be mentioned that this writer more than a decade ago already pointed out these problems, for instance the potassium problem in his book *Bio-Dynamic Farming and Gardening.*

8. The importance of microorganisms in soil is being recognized more and more widely. It is a peculiar phenomenon than an authority in soil microbiology who has actually laid the foundation for the understanding of this microlife, such as S. Waksman objects to organic practices which are a direct consequence of his own findings. But then, we have the fact anyhow that, for decades, applied soil microbiology has been treated like Cinderella in agriculture; most of the researchers and practitioners being fascinated by Liebig's mineral fertilizer theory. Fundamental works on soil microbiology have been written as far back as the beginning of the century. But the knowledge contained in them has never been practically applied until very recently. Had our agriculturists carefully studied Liebig's own work in all its details they would have discovered that towards the end of his career he had certain doubts in regard to his own mineral theory. He discovered that certain soils did not fit into the theory. These were heavy, dark brown humus soils in the Danube plains which yielded high in spite of "apparently" no fertilizer being applied. Also the testing of these soils did not reveal the true situation of their fertility. These soils were high in organic matter. It would appear that the Liebig theory applies to worn out, mineralized soils, but not to soils with a high organic rating. Just imagine, there would have been no soil erosion, no need for soil conservation, no trace mineral deficiencies, if Liebig's doubts had been noted and taken as seriously as his fertilizer theory. It just demonstrates how a one-sided point of view can produce an apparent success for a short time followed by a bitter awakening.

An excellent little brochure on the subject is *Microorganisms and their Effects on Crops and Soils* by T. M. McCalla and T. H. Gooding. Nebraska Agricultural Experiment Station. Circular 90. March 1952.

9. The newer concept in soil fertility and microbial activity is probably best described in an article by F. Lyle Wynd, *Feed the Soil,* The Scientific Monthly, Vol. LXXIV, No. 4, April 1952, page 223. This is undoubtedly one of the most important publications of the year. Men like Firman Bear and Lyle Wynd merit commendation, for they have grown up and become renowned scientists with the fertilizer theory. But they have not stood still with it and are ever searching scientists on the path to a deeper understanding of soil life. The following quotations from Lyle Wynd's article more than substantiate what this writer wishes to express.

"There is an ever widening rift between the policies of the fertilizer industry and those based on the results of research in the fundamental properties of soil. This rift can no longer be ignored by the fertilizer industry for already it has lessened significantly the effectiveness of the industry as a partner in the general agricultural program. Somewhere along the line of its industrial program the fertilizer industry has missed the boat." He then mentions the two schools, the need of cooperation. "This cooperative effort," he continues, "depends on the well-placed confidence of the farmer in the organizations that sell him fertilizer, and such confidence is incompatible with the present confusion and uncertainty. What the farmer does not realize is that he is the victim of an error and that he has fallen into the seductive arms of modern advertising.. The error is sometimes forced upon him in ignorance, but many examples of advertising propaganda could be collected that are so obviously absurd that one is forced to believe that the farmer is the intended victim of a deliberated campaign."

These are the words, not of an organic faddist, but of a professor at Michigan State College. One can only hope that he can stay there and will not be out of a job for these courageous words.

He demonstrates that fertilizer is not plant food at all (the favored term of fertilizer legislation and formula declaration) but at its best can be only food for the soil; that plant food is contained in the humus of soil and prepared by microorganisms, i.e. made available by them so that roots can absorb it. "We believe that the concept of fertilizer as specific plant food is not entirely correct, and that the misconception has been popularized by the advertising program of the fertilizer industry. We have no quarrel with the industry itself. Our only intention is to call attention to an error that has resulted in so much harm to

the industry and to the farmer . . . Soil scientists and plant physiologists, however will tell the farmer that plant foods are components of the colloidal and dynamic biological complex of the soil, and that plants obtain their foods from complex organization, in a manner of speaking, only by permission of the soil.

"Our discussion will be based on two fundamental characteristics of soils. The first is that soil is biologically alive and second that its colloidal properties govern the release of food to the plant. We might say, in other words, that the nutritional aspects of soil fertility depend on activities of living microorganisms and on the electrical properties of its non living, colloidal components. Our first task will be the consideration of the organic life in the soil, because all that the soil is or may become depends on it. Soil is alive, truly, actually, and literally alive. Soil is not soil until it is alive and no amount of chemical plant food mixed with dead, finely ground rock particles would produce the equivalent of a productive soil." (Again, for the record, it may be pointed out that this has been the main thesis of this reporter for over two decades.)

"Soil must be something more than a mixture of fine particles and chemical plant food. This "something" is the result of the living nature of soil and it must be the basis of permanent soil fertility. It must be preserved. If it be preserved, all is well. If it be not preserved, no amount of "plant food" dispensed from sacks will itself remedy the loss."

Wynd emphasizes the need of *living* organic matter, teeming with microorganisms. "A soil was never fertile because it contained inorganic plant food and dead organic matter. The life of the soil is not synonymous with the organic matter. If we admit that the living microorganisms in soil must thrive in order to maintain and augment fertility, then we must also admit that the maintenance of this living population is of great importance. These organisms require food . . ."

"The supply of nitrogen, phosphorus, and sulfur, and of many other plant foods as well, is completely dependent on the metabolic cycles undergone by these microorganisms. If we think of fertility in the long-time sense, we must first think of the biological and colloidal requirements of the soil itself and only secondarily of the nutritional needs of specific crops . . . . It is amazing to a soil scientist, and he chuckles inwardly with pedantic satisfaction, when he hears a farmer's lament that he has added so many pounds of phosphate per acre and obtained no significant increase in the yield of corn. It is lucky for all

of us that he was unavoidably feeding bacteria and thereby preserving some of the essential properties of soil for a future and more intelligent master . . . "

"Any concept of fertilizer as plant food, to the exclusion of its importance as a soil food is based on the belief that the plant can be fed directly without first feeding the soil. Such a niggardly practice is uneconomical for the farmer in the long run. His soils will unavoidably deteriorate if he practices it over any considerable period of time, and this will force him to use more plant food, with still greater deterioration of the soil. Such a practice is contrary to a sound agriculture, contrary to the ideals of the conservation of fertility, and therefore anti-social and unpatriotic. The long continued use of mineral fertilizers as a plant rather than as soil food always leads ultimately to a decline in productivity. Because this decline is extreme in some instances, there is an increasing resentment toward the use of mineral fertilizers among a group of fanatic faddists. Unfortunately for the fertilizer industry, the argument of these fanatics is based on facts, making their absurd conclusions embarrassingly difficult to attack." Let's leave out the fanatic faddist and get down to brass tacks, in this case the maintenance of soil fertility, humus, and microlife and there will be sound cooperation.

A COSMIC ERROR

The earthworm spends a life of toil
Producing rich and fertile soil—
All entomologists agree
He does no harm to plant or tree—
But gives his efforts to enhance
The value of their sustenance.

The chinch bug, moth, the weevil, and
Some other insects all depend
Upon the products of the wheat;
It isn't flour to them,—it's meat.
They do far more than storms or frosts
To elevate production costs.

And yet a cruel trick of fate
Makes earthworms valuable for bait,
And, owing to the fisherman,
Their lives are but the briefest span;
But milling pests in loot engage
Until they perish of old age.

The reason why, I do not know,
That matters should be thus and so—
But, dug up for a fish's meal,
The earthworm gets a dirty deal,
While in the wheat field or the mill
The hungry beetle eats his fill.

—Harvey E. Yantis, in The Northwestern Miller of a Quarter of a Century Ago.

GRINDSTONE RUN BECOMES A SUMMER STREAM

STERLING W. EDWARDS

Suddenly and without warning Grindstone Run slips smoothly into the green mystery of summer, with here and there in the deep pools a piece of blue sky reflected. Far off tractors are busy at corn field readying, but on the home place here books and birds and making the new herb garden occupy us as we become slowly and deeply walled in, within this fresh green peace.

WE HAVE NOW BEEN USING OUR NEW LEE HOUSEHOLD MILL for some months. This device is as modern in appearance as any other kitchen equipment and can be easily handled by any woman. It is a very simple matter to plug in the mill before doing breakfast dishes and by time beds are made your flour is fresh ground for immediate mixing. So far, it seems to have solved for us the flour grinding problem.

The mill makes no dust in the kitchen, will turn out 5 to 6 lbs. per hour of wheat flour and a little less of rye, as well as other similar size grains, but not cornmeal. An adjustable mill of the same make can be had for both flour and cereal. Our mill has been a joy to us since the day it arrived.

THE CURTAIN LIFTS A LITTLE. It is now slowly dawning on many basic food nutritionists that the food industry all too often substitutes manufactured junk and general trash for healthful home prepared dishes. When it is recalled that such devitalized stuff is acreage raised, fertilizer fed, well-sprayed with a number of very poisonous chemicals, picked today and reaches the cannery next Thursday, it won't be too difficult for the BD gardener to resolve to make his present garden a little larger and a little better.

WE ARE CONSTANTLY QUESTIONED. We make a lot of replies to folks who want to know about our grinding, our gardens and the foods we buy elsewhere. Some are serious in really wanting to improve upon the general low level of "boughten trash" they serve up 3 times a day. You can put in a lot of time trying to help in this fashion and we are afraid much of it is wasted effort. Too many are more interested in finding "good" places in which to "eat out," rather than in *how and what* to prepare at home. And here in the country, while many raise of vegetables and meat a goodly supply, they still piece out and embroider the edges with a sizeable array of packaged stuffs from cereals to enamelled cookies and cake mixes.

But for many families the preparation of basic, natural foodstuffs, so important for the growing good health of the younger generation, is of increasing importance and a matter of great concern. These folks spend larger portions of the family budget for that which they consider of unquestionable worth nutritionally, but, alas, they are offset by the thousands who know nothing of good foods and whose sole diets in some instances are mainly such products as cannot, in many instances be fed to animals.

WHAT FOODS ARE BASIC AND NATURAL? We have written previously in this magazine of wheat, rye, cornmeal, honey, butter and milk as basic foods to be acquired at their sources, and the reader should refresh his memory thereon. Other foods, always to be organic products, essential to good health, are fresh goat milk, natural figs, sunflower seeds, yogurt of combined B. cultures, flax seed meal, rice polish and raw wheat germ. In addition, of course, there are all the products of your BD gardening and farming.

BASIC NUTRITION. The more you become interested in basic nutrition, the less respect you have for the maudlin imbecilities sung to you on the radio. The long list of publications and reprints now available on this subject (for a few pennies each) will prove very upsetting to you and your thinking. I will be glad to furnish lists of each publication to anyone really interested.

You are, eventually, left with your garden, your own chickens and bees, a steer and your own carrots. You can eat these items from other sources but you won't ever trust them again nor have a free mind. It's all in the record; you can read it for yourself.

You will want to be as certain as you possibly can, that the small piece of land you plan to move to in the country, as you cast the city behind you someday, is not to be subjected to airplane spraying or dusting, or roadside treatment, or, for that matter, drifting from the spray program of a nearby orchard, farm or ranch. As these programs expand, on cropland and timberland, no one will be safe from poison drifting unless he moves to an island off the coast. The agricultural situation in this country just goes from bad to worse and a government official told me sometime back that every new insecticide just leads to the need for a stronger one as insects develop immunity. The new sprays can't be washed off apples and peaches and

pears. They penetrate the fruit. You have to eat them along with the apple. It's all in the record!

This MATTER OF MAKING BREAD. Begin by believing that it is not necessary to teach your family to slowly and painfully acquire a taste for a heavy, soggy, watery, brown-and-blackish brick of a loaf. Your whole wheat loaf, on the contrary, baked 2 or 4 at a time, can be as light and airy and spongy and delicate as any product of the bakers' art. Thus you may have either kind of loaf.

You need to decide whether you want a highly nutritious loaf, filled with various items like extra wheat germ or extra powdered skim milk; or whether you just want an ordinary, homebaked, run-of-the-mine, up-and-down-and- round-the mountain loaf of bread. Either kind is good.

If you expect to achieve the results we get, you will need to duplicate our ingredients from your area. You can get powdered skim milk from a milk plant; ours comes, made the day before, at 18c per lb., and our wheat is locally raised in Maryland, high in the mountain,- organic soft winter wheat, 10 months old before we grind it in a Lee mill (or use a similar mill) powder fine.

We have tried a number of recipes and it seemed evident after repeated trials that the writers were using ingredients other than those available to us, so that over the years we have had both good and bad luck with the general run of recipes. Finally we got Paul Keene's recipe and since then—no trouble. But it won't work with coarse ground whole wheat flour!

In Keene's recipe (he farms at Penns Creek, Pa., and sends organic products all over the country) we substitute 2 cups of hot water for the scalded milk and add ½ cup of powdered skim milk, for extra food value, but if you have your own cow, you can forget the p.s.m. as we do if we happen to have any local milk.

Here is the recipe which is taken from one of his information slips:

> "WHOLE WHEAT BREAD—2 loaves. 2 cups scalded milk, 2/3 cup lukewarm water, 4 tbs. molasses or honey, 2 tbs. melted shortening, 1tsp. salt, 2 pkgs. dry yeast, 6½ cups whole wheat flour."
>
> "Stir 1 tsp. sweetening into water to which yeast has been added, and let stand 10 minutes. Add remaining sweetening and salt to hot milk and cool to lukewarm. Combine yeast and milk mixtures, stirring well. Stir in 3 cups of flour, add shortening, mix well. Then add remaining flour gradually, mixing thoroughly. Knead 10 minutes on lightly floured board. Allow to rise in covered bowl in warm (85 degrees) place free from drafts for

about 1 hour, till double in bulk. Then divide in half on board, cover and let rest 10 minutes. Shape into loaves, place in greased pans, cover, set in warm place again for another hour. Place in 400 degree oven for 15 minutes, and reduce heat to 375 for about 45 minutes longer."

"This is the most fool-proof recipe we know of. Scalding the milk and using small breadpans (4½" x 8½" x 2¾") seem to be the two details that help most to keep the bread from being holey and sunken!"

Molasses makes the loaf dark, but you can use honey or raw sugar. Either one or any combination is alright, as is butter or lard. Bread pans measured across the top, as given above, are correct. Use 1 envelope of yeast for each loaf of bread, no less, but if you work over into homemade yeasts from a Civil War cookbook, you will probably need to do some experimenting, as present day wheats are different from 1860 grains.

Now, should you be a little mite uncertain about handling doughs (called sponge) you can start out with rolls, and not make loaves. Rolls are just "little" loaves, except they bake in 15 minutes instead of 1 hour. To start, use a 2 loaf recipe for a family of four, a 1 loaf recipe for a family of 2, and you can see how it goes. Make your rolls round and flat to finish up about 3½ by 1 inch as high, don't let them touch in flat sheet-cake pans, and later you can make them otherwise, if you desire. Rolls take 400 degrees for 15 to 20 minutes, but watch them!

So, start out with basic ingredients, and gradually acquire the feel of whole wheat sponges; later, you can improve your loaf if you like by additions of several enriching items.

THE GARDENER

from the Book by L. H. BAILEY

Keep them going,—this is the watchword of the good gardener. Allow the plants to suffer no check from start to finish: transplant seedlings before they crowd and into good well-prepared soil; see that the plants are well thinned; till frequently; prevent a crust from forming on the ground; water when necessary; keep down weeds; look for the first signs of bugs and diseases and apply the proper remedies with diligence; of ornamentals, remove the seed-pods as soon as the flowers begin to fail; in fruit plants, thin the fruits punctually; have new plants on the way to take the places of the old ones; at every step, watch and act; if you like your plants intensely, they will respond. The good gardener grows plants in all kinds of weather: that is his job.

AVAILABILITY OF NITROGEN, PHOSPHATE AND POTASH IN SOILS DUE TO APPLICATION OF MICROORGANISMS

EHRENFRIED E. PFEIFFER

The role of microorganisms in soil is twofold. For one, they digest organic matter and build up humus. On the other side, some produce carbon dioxide, others produce organic acids, and these in turn digest or dissolve mineral particles. The more bacteria present in the soil, the more these digestive and dissolving activities go on. It is in the interest of the farmer, therefore: (1) to have the right kind of organisms present, (2) to stimulate their growth and (3) to maintain such conditions of aeration and moisture that microorganisms can multiply and fulfill their task.

It has been observed that in certain soils mineral elements can be locked up or become unavailable. The best known case is that of phosphates in alkaline soils which can become unavailable to a high degree. The U. S. Department of Agriculture Experimental Station in Beltsville, Maryland, stated several years ago that only 2 to 10% of the phosphates (at best, 20%) applied in fertilizers remain available. The rest may be locked up and become inefficient for plant growth. We know of soils which showed practically no available potash but a total chemical analysis for potash revealed that there were still 50,000 lbs. of potash per acre,—unavailable. Nitrogen likewise can be locked up in the form of organic nitrogen. Well known is the case that raw manure, and also undecomposed plant matter, as in plowed-under green manuring, can tie up nitrogen for a considerable length of time.

Science for a long time has known about these facts, but has given them a kind of Cinderella position in practical application. Pfeiffer has studied this problem very carefully, and has designed methods by means of which specific microorganisms (bacteria) can be multiplied at a rate heretofore unknown and can be inoculated into the soil, influencing the production of humus, as well as the availability of minerals.

The B. D. Compost Starter, which breaks down organic matter without tying down nitrogen and making minerals unavailable, was first developed. Later on the Comco Bacterial Spray was developed, which contains a high amount of such beneficial microorganisms which mobilize soil minerals. Pfeiffer

has tried out his discovery on his own and other farms. It was found that the organic matter level in soils could be raised from 2 to 4% in the short time of 3 to 4 years, provided that a proper soil management was maintained. It could be also demonstrated that the bacterial count of soils could be increased to a height heretofore unknown. While older text books mention that the bacteria count of soils, as tested with the plate counting method, was as low as 10 to 100 million per gram of soil, best virgin humus soils showing a count of 500 million, it is no longer even considered surprising when counts going into the billions are obtained after the application of the B. D. Compost Starter and the Comco Bacterial Spray.

The table below shows the increase of availability in a laboratory experiment. A heavy adobe soil from the Oakland, California area was put into pans. One group was treated with the Comco Bacterial Spray as it is applied nowadays in the field. The other group remained untreated. One important factor for building up soil bacterial life is moisture. The soil, therefore, was kept slightly moist throughout the test period. In dry soils nothing happens. The soil was tested for nitrate, ammonia, available phosphate and available potash before the experiment. Then the Bacterial Spray was applied and raked into the soil. (In the field one would spray the cultures, disc the soil and irrigate immediately afterwards, unless the spray goes on a wet soil and is washed down at once by rain). In intervals of 1, 2, 3, 4½ and 6 weeks after the application, the soil was tested again for nitrate, available phosphate and potash. The figures speak for themselves.

Increase of Availability of N P K in Soils as result of Application of Com-Co Bacterial Spray
An Adobe Soil was treated with the Bacterial Spray and kept moist for 6 weeks.

Findings of available minerals:	Nitrates		Phosphates		Potash	
	lbs./acre	increase	lbs./acre	increase	lbs./acre	increase
At start	64	–	30	–	500	–
After 1 week	96	50%	60	100%	500	0%
After 2 weeks	192	200%	80	166%	700	40%
After 4½ weeks	320	400%	160	433%	900	80%
After 6 weeks	384	500%	280	833%	1800	260%

The importance of these findings is that minerals can now be made available at the time when they are really needed for plant growth. Of course a soil has to be well manured and fertilized to be able to do so, but these fertilizing practices can also be made much more efficient. In the field the result of this bac-

terial treatment depends on the proper aeration (cultivation) of the field and the maintenance of moisture. The result will depend also on the quality of soils. Poor soils with a low organic matter react much slower, because organic matter (humus) has to be built up at first. This can be done with the application of manures, compost, organic fertilizers. Mineral fertilizers will become much more efficient, because the danger of being locked up is reduced. Soils with 2% organic matter and better, respond much faster. Here considerable amounts of nitrogen and other mineral reserves are present, from which the microorganisms can draw. A living soil, with 2% organic matter, contains for instance, 40,000 lbs. of "digested" humus, with a total nitrogen reserve of 2,000 lbs. From this the microorganisms can draw and transform the organic nitrogen in nitrates and/or ammonia. Since the presence of free ammonia, especially in an alkaline soil can lead to losses, especial care has been taken to eliminate ammonia-forming bacteria and only nitrate-producing organisms were included in the spray. It was also observed that a slightly lower pH could be obtained. The original pH of the tested soil was 8. After six weeks it was 7.6, which means that the alkalinity has been slightly reduced.

The application of the bacterial treatment lends itself very well to mobilizing soil life after the cool winter period; after a drought when life has come to a standstill; after manuring and green manuring, or when straw, stubble, crop leftovers are disced under. It can also be used as a pre-emergence spray before seeding, with the last cultivation which prepares the seed bed. This will help plants to provide more available plant food at a time when they need it most. Since it has been established that the bacterial effects are slow coming and need an initial period of two to three weeks, it is best to apply the spray in advance, for instance, four weeks before the maximum effect is desired.

The question has been raised as to whether the process can go too far and too much availability might release too much at a time. This danger has not been observed as yet, in many years of experimental and field studies. On the contrary, it has been observed that a balance establishes itself after some time. Nature, by means of drought and heat, has a regulating influence and will control the entire process. If, after the initial period of increased soil life, the plant roots grow into the deeper moisture-carrying layers and the surface soil dries out, the bac-

terial life comes to a standstill anyhow. The microorganisms go into a dormant state, to be revived only with each additional rain or irrigation.

One thing should be remembered at all times: Feed your soil and microlife and this in turn will feed your plants. Build up soil reserves from which to draw. Don't look for quick results and quick decline. Learn to grow.

BOOK REVIEWS

PRINCIPLES OF WEED CONTROL by Gilbert H. Ahlgren, Glenn C. Klingman, Dale E. Wolf. John Wiley & Sons, Inc., New York. 1952.

Those of us who have in recent years been lured by the sweeping claims of many of the weed killers advertized for home garden use (secretly thinking how nice it would be to be able to let the old hoe rust) and then suffered bitter disillusionment when one dose didn't do everything, or when one dose flattened the string beans and left the weeds flourishing, would do well to read this book. Many details of this relatively new science are still to be tested. Chemicals which are effective against some weeds are resisted by others. Sometimes this is due to the time of application, the weather conditions, dry, wet, or to the condition of the soil reaction or some other factor.

The evidence offered by the many tables, careful analyses, descriptions and reports of experiments carried out with the various chemicals and the listings of results given in this efficiently organized book supports the previously held suspicion of the reviewer that chemical control of weeds is a truly complicated affair. In some cases, for instance in the eradication or control of broad leaved weeds in pasture and haylands here in the East the problem is complicated by the fact that our pastures and haylands usually contain a fair amount of the various clovers most of which are either checked in their growth or completely driven out by all of the chemical herbicides, although most of the grasses are uninjured by many of them. In such situations, the authors recommend mechanical methods of control such as clipping and grazing to prevent annuals from seeding and to discourage perennials by removing the tops at the time when they would be starting to send food reserves down to the deep roots, as well as stimulating the rapid growth of the grasses and clovers by applications of fertilizer and manures (free from weed seeds) so that they are able to crowd out the weeds. One thing they tell us, in connection with lawns, did

the hearts of the editors of *Bio-Dynamics* a lot of good. They advise against clipping lawns too short, since this tends to starve the grass roots in some cases, bare spots appear, and then when conditions are just right, crab grass, for example is apt to take over. We have preached letting the lawn have a little leafage to feed its roots for years, not cutting too early in the season, and allowing the newly seeded lawn to grow much longer than most fond owners want before cutting. One exception to this rule is the various bents, which by their peculiar growing habits respond to close clipping. That's why they are used for golf courses, putting greens rather.

Some deep-rooting perennial weeds cannot be eradicated from pastures except through crop rotation, planting to cultivated crops for two or three years. Most respond to this sort of treatment. One of the statements put forward in favor of chemical weed control is that it costs less per acre than some of the old-fashioned methods of cultivation or hand weeding, or grubbing out. On the face of it, $10 to $20 per acre as against $100 to $200 an acre with old methods sounds like a saving. However, the authors go on to state in many cases that applications of the chemicals must be repeated for several years besides mowing in the case of pastures and haylands or cultivation of row crops if these are inserted in the rotation as means of control. Of course, they also state that the number of cultivations necessary is often reduced by the use of the chemicals. Nevertheless, it seems to me that often it almost balances out in the end, so that the farmer with good management, maintenance of soil fertility, and intelligent rotations, probably will be able to control weeds in his fields as economically as the one who uses the new herbicides.

When it comes to the matter of weeds in vegetables the authors tell us that "although the advent of chemical weed control has led to its adoption in many of the cereal and field crops, chemicals have proved highly injurious to most vegetables, and chemical weed control in vegetable crops has been consequently limited." Several vegetables are relatively resistant to some of the chemicals and they have been applied to these crops in the case of large commercial plantings with good success. Obviously, for the home gardener chemical weed control is worse than useless. All kinds of beans and peas, for instance, are very sensitive to all of the herbicides. Citrus orchards are the only ones in which a certain amount of experimenting has been done, and amongst the small fruits, some success has been

achieved in limited localities with strawberries and raspberries.

As a matter of fact, the authors never claim that chemical weed killers are the whole story; indeed, they tell us again and again that they really can only be considered as a very helpful supplement to time-tested methods of cultivation, rotation, and so on.

ELEMENTS OF PLANT PROTECTION by Louis L. Pyenson, Ph.D. John Wiley & Sons, Inc., New York. 1951.

Dr. Pyenson presents the whole of problem of plant protection and the fundamental reasons for its scope in his introduction in a way that could lead one to consider it a biological problem which might one day be solved by re-establishing equilibriums in nature which man has disturbed in one way or another. However, he apparently feels that we have gone too far to even attempt to do this.

"He has taken the most tasty, nourishing, or beautiful of these plants and learned how to reproduce, grow, and improve them, not in the manner of Nature, in scattered units among thousands of other types of competing plants, but as millions upon millions of identical plants covering, in some cases, hundreds of acres.

"But all this is contrary to Nature's way of life, this hurrying and shaping plant evolution to suit man's own needs, this concentrating of single species of plants on the one hand, and of man and his domestic animals on the other. Nature works in centuries, but man in a period of 50 years has speeded up or by-passed natural evolution and has produced changes in North America that have led to the creation of many grave problems of plant protection. Our agricultural economy has reached such a stage that, if insect-, disease-, rodent-, and weed-control measures for our crops were suddenly stopped in the United States for a few years only, starvation would stalk the country, and huge segments of our population would be wiped out by the ensuing famine. Our highly developed agricultural and horticultural production has been made possible only by parallel developments in our knowledge of the various factors causing crop losses, and of ways of dealing with many of them quickly and effectively."

This last statement makes me think of a man in a boat with moderately large hole in it who is found making the hole larger because he has the means of plugging it up just before it is too late, with him in the boat; as a matter of fact he really has more than enough stuff to mend the first hole and it would be such waste not to use it all up!

However, quite apart from my little quarrel with the gentleman's point of view, this is an excellent book. It is well illustrated by line drawings (Emily B. Steffens) and photographs, the text is clear and readily grasped by the lay mind. One learns the different types of insects and how to identify them, what sorts of poisons will be most effective, as well as all the various plant diseases and enough about symptoms primary and secondary at least to be able to ask intelligently for help and information from those qualified to give this, Farm Bureau, U.S.D.A., etc.

Applied controls are also dealt with, both mechanical and biological, adjustments of planting times to avoid certain insect attacks, changes of crop, rotation, maintenance of soil fertility, besides very nearly declaring himself in favor of diversification, at least by implication, (but perhaps I am going too far).

Excellent tables are given listing insects and plant diseases and various possible chemical controls, insecticides, fungi sprays and dusts. All the sprays and dusts of organic origin are also given. Weed control is also described and mechanical equipment necessary for the application of all these remedies. It covers all the problems and possible solutions thoroughly and in a lively fashion. Recommended for a comprehensive picture of the way things stand today in this broad and complicated field.

ALICE HECKEL

COOKING WITH WHOLEGRAINS. By Ellen and Vrest Orton. 64 p.p. Farrar, Straus and Young, Inc., New York, $1.75.

This little book is in its third edition, showing that it has filled a real need for information about how to use the whole grains. The first two editions were published at the Vermont Country Store by the young couple whose personal culinary experience is behind the collected recipes. For the wholegrains they began using a 150 year old mill in Weston and from it has developed the Store, which now supplies many other folks besides the Ortons. Nothing is said of how their grains are grown, which the Bio-Dynamically-minded individual will consider as important as the processing. However, the recipes will be a great help to those who want to use Bio-Dynamic wheat, rye and corn.

Cooking with these rich, flavorful flours, cereals or meals is an art in itself, different and often more simple than the methods needed for the lifeless, refined materials; so if you

don't know how to bake, remember it is easier to learn with wholegrains. Personally I think that the wholewheat bread recipe here is more complicated than need be, but it seems that every bread maker has to work out her own preferred method after she has learned the basic principles. There are certain adaptations which one must make in working with wholegrains and the recipes here have taken this into account. For example, wholegrains contain a good deal of natural sweetness and so less sugar is required,—or I would prefer to say honey, but here again alterations are needed. None yet has worked out sufficiently the combinations of wholegrains and honey. The honey recipe books still call for refined flours. The fatty part of the grain germ is present in wholegrains, so one can do with less fat. The proportions of dry and liquid ingredients are quite different too. Temperatures and baking times may vary somewhat. So do not think you can take any recipe calling for flour, meal or cereal and just substitute whole grain for the anaemic white stuff.

There are chapters on Bread and Rolls; Quick Breads, Steamed Breads and Doughnuts; Muffins, Popovers and Gems; Biscuits, Griddlecakes, Scones and Dumplings; Luncheon and Supper Dishes; Desserts and Cereals. Wholegrain pie crust is a delectable item. Short cake, fruit cake, brownies, fritters, puddings and waffles are particularly good made with the wholegrain. Such names as Pioneer Hoe Cake, Samp, Corn Dodgers, Hermits, Firmenty, Indian Pudding and Yorkshire Pudding take us back many years.

In fact, many of these are old recipes revived from the time over a hundred years ago when refined grains were yet unknown. The famous French chefs of the 18th Century, sometimes looked upon as the greatest cooks of all time, used only wholegrains. This book, however, is not for professionals but for everyday home use. One of its advantages is that it calls for only the common and easy-to-get materials.

Vrest Orton has supplied the illustrations and a delightful introduction but the recipes are his wife's. He admits—one might almost say brags—that he cooks only "by ear" and so could never have written down his methods. But he assures us that from every recipe in the book, food has been cooked and eaten, often many times.

EVELYN SPEIDEN

WANTED!!

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